Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Ridgewater College Hutchinson

Date: 6/5/2012

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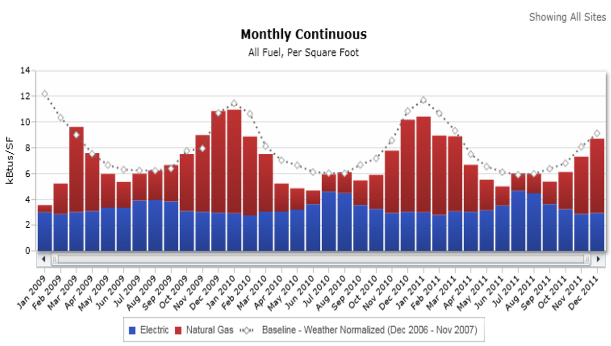
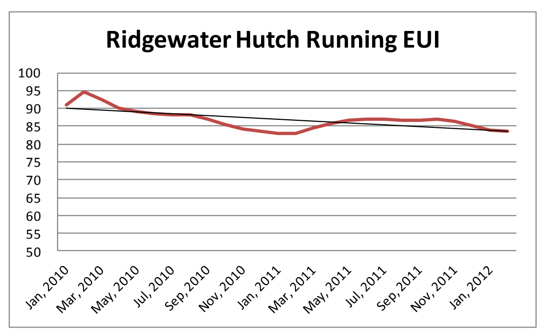
PBEEEP
State Government

Ridgewater College Hutchinson Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Ridgewater College Hutchinson was performed by LHB, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$54,121		Total Project Cost	$63,667
Future costs including Implementation , Measurement & Verification	$9,546		Study and Administrative Cost Paid with ARRA Funds	($56,121)
Total Project Cost	$63,667		Utility Co-funding	$0
			Total costs after co-funding	$7,546
Estimated Annual Total Savings ($)	$3,779		Estimated Annual Total Savings ($)	$3,779
Total Project Payback	16.8		Total Project Payback with co-funding	2.0
Electric Energy Savings	**2.1%**	**and**	**Natural Gas Savings**	**0.6 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	195,906	16,378,660	19,074,648	-2,695,988	-14%	$297,084.04	$0.02
2010	365	195,906	16,362,001	18,689,860	-2,327,859	-12%	$291,108.70	$0.02
2011	365	195,906	16,658,188	18,453,211	-1,795,023	-10%	$298,308.53	$0.02

Ridgewater College Hutchinson Consumption Report
Total energy use decreased 1% during the period of the investigation

Admin Minnesota DEPARTMENT OF ADMINISTRATION STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Ridgewater College Hutchinson	
Location	2 Century Ave SE Hutchinson, MN 55350
Facility Manager	Dan Kip Oveson
Interior Square Footage	195,906
PBEEEP Provider	LHB, Inc.
Project Manager	
Annual Energy Cost	$298,308 (2011) Source: B3
Utility Company	Hutchinson Utilities Commission (Natural Gas and Electricity)
Site Energy Use Index (EUI)	83 kBtu/ft^2 (at start of study) 82 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	129 kBtu/ft^2

Building Name	State ID	Square Footage	Year Built
East Campus	E26271T0684	18,500	1984
Main	E26271T0172	80,000	1972
Maint Shop	E26271T0792	4,000	1990
Media Resource/Library	E26271T0801	45,316	2001
Mezzanine	E26271T0475	2,090	1975
Northeast Wing	E26271T0375	19,000	1975
South Wing	E26271T0275	15,000	1975

Mechanical Equipment Summary Table (of buildings included in the investigation)

Quantity	Equipment Description
1	Building Automation System (Schneider Electric)
8	Air Handling Units
21	Roof Top Units (18 RTUs on main campus, 3 RTUs on East campus)
7	Hot Water Boilers
1	Chiller
9	Pumps (Chilled water and Hot water)
1	Water to water HX
1	Fan coil units
9	Powered Roof Ventilator
4	Fume Hoods
122	Variable air volume boxes
2,315	Points On the Automation System
670	Minimum Points To Be Trended

Implementation Information			
Estimated Annual Total Savings ($)			$3,779
Total Estimated Implementation Cost ($)			$7,546
GHG Avoided in U.S Tons (CO2e)			42
Electric Energy Savings (kWh) 2.1 % Savings 2011 Electric Usage 2,171,551 kWh (from B3)			45,026
Electric Demand Savings (Peak kW)			0
Natural Gas Savings (MMBtu) 0.6 % Savings 2011 Usage 87,559 Therms from B3			543
Statistics			
Number of Measures identified			3
Number of Measures with payback < 3 years			1
Screening Start Date	2/15/2011	Screening End Date	4/22/2011
Investigation Start Date	6/24/2011	Investigation End Date	4/30/2012
Final Report	6/5/2012		

Ridgewater College Hutchinson Cost Information		
Phase	**To date**	**Estimated**
Screening	$2,400	
Investigation [Provider]	$45,346	
Investigation [CEE]	$6,375	$1,000
Implementation		$7,546
Implementation [CEE]		$500
Measurement & Verification	0	$500
Total	$54,121	$9,546

Co-funding Summary	
Study and Administrative Cost	$56,121
Utility Co-Funding - Estimated Total ($)	$
Total Co-funding ($)	$56,121

Facility Overview

The energy investigation identified 1.3% of total energy savings at Ridgewater College Hutchinson with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Ridgewater College Hutchinson are based on adjusting the schedule of equipment to match actual building occupancy hours, recalibrating economizer sensors, and correcting the operation of the roof top units to take full advantage of economizing. The total cost of implementing all the measures is $7,546.

Implementing all these measures can save the facility approximately $3,779 a year with a combined payback period of 2.0 years before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 2.1 % electrical savings and 0.6 % natural gas savings. The building is currently performing at 35% below the Minnesota Benchmarking and Beyond database (B3) benchmark; energy usage during the period of the study declined by 1%.

The primary energy intensive systems at Ridgewater College Hutchinson are described here:

Ridgewater College Hutchinson is a 195,906 square foot (sqft) complex located in Hutchinson, MN. The buildings primarily consist of classroom space, laboratory, library, and administration space.

Mechanical Equipment

There are a total of seven boilers which were installed in 2000 that supply hot water for heating to all mechanical equipment in the main campus. There are two separate hot water loops associated with boilers. One is hot water directly from the boilers and is used primarily for the VAV reheats. This loop contains three hot water pumps all of which have VFDs. The other loop runs through a water to water heat exchanger which transfers energy from the hot water from the boilers to a glycol hot water loop which serves the heating coils in the AHUs. This loop consists of two hot water pumps which also contain VFDs.

There is an air cooled chiller which produces chilled water for eight AHUs located at the main campus. The chiller has a primary chilled water pump and secondary chilled water pump. The secondary chilled water pump utilizes a VFD.

The main complex contains eight AHUs and eighteen RTUs. All the RTUs utilize DX cooling. Thirteen of the roof top units and three of the AHUs contain VAV boxes; the campus contains a total of 122 VAV boxes with reheat coils. The science RTU contains an energy recovery wheel due to the large amount of exhaust air from the space.

The East Campus contains three RTUs which are gas fired and contain DX cooling. They serve multiple spaces and are controlled by single thermostat located in one of the spaces the unit serves.

Controls and Trending

The main campus building runs on a Schneider Electric-IA automation system. The system is capable of trending and archiving trend information. A log in to Workplace Pro would be required by a provider to further set up trends. Currently all major mechanical equipment located within the main campus structure is automated. The system has approximately 200 points being trended right now.

The RTUs at the East Campus are controlled by thermostats mounted on the wall, there is currently no automation for this complex and data logging would be required for trending at this complex.

Lighting

<u>*Indoor lighting-*</u> Interior lighting consists of T8 32 watts lamps. There are few areas which still have T12 lights, but these areas rarely have the lights on and the savings associated from replacing them would not be significant. Most of the lights are controlled by light switches.

Energy Use Index B3 Benchmark

The site Energy Use Index (EUI) for the building is 83 kBtu/sqft, which is 35% lower than the B3 Benchmark of 129 kBtu/sqft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows Ridgewater College Hutchinson is performing better than the average state building.

Metering

The complex contains two electrical meters for the main campus, one which feeds all the main buildings and another electrical meter for the Maintenance Shop. The east campus contains one electrical meter. There are two different gas meters, one for the main campus and one meter for the East Campus.

Findings Summary

Building: Main Campus

Site: Ridgewater CC Hutchinson

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	AHU and RTU Operation Schedules Need Optimization	$2,682	$2,907	0.92	$0	0.92	33
3	Over Ventilation.	$3,682	$743	4.96	$0	4.96	7
2	Economizing Operations	$1,182	$129	9.13	$0	9.13	2
	Total for Findings with Payback 3 years or less:	**$2,682**	**$2,907**	**0.92**	**$0**	**0.92**	**33**
	Total for all Findings:	**$7,546**	**$3,779**	**2.00**	**$0**	**2.00**	**42**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Ridgewater

Finding Type Number	Finding Type	Relevant Findings	Looked for, Not found	Not relevant
a.1 (1)	Time of Day enabling is excessive	1		
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	1		
a.3 (3)	Lighting is on more hours than necessary.		1	
a.4 (4)	OTHER_Equipment Scheduling/Enabling		1	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	1		
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set	1		
b.3 (7)	OTHER_Economizer/OA Loads		1	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive		1	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		1	
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints		1	
c.4 (11)	OTHER_Controls			1
d.1 (12)	Daylighting controls or occupancy sensors need optimization.		1	
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.		1	
d.3 (14)	Fan Speed Doesn't Vary Sufficiently		1	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently		1	
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary		1	
d.6 (17)	Other_Controls (Setpoint Changes)			1
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal		1	

e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			1
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal		1	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			1
e.6 (22)	Other_Controls (Reset Schedules)		1	
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		1	
f.2 (24)	Pump Discharge Throttled		1	
f.3 (25)	Over-Pumping		1	
f.4 (26)	Equipment is oversized for load.		1	
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction		1	
g.1 (28)	VFD Retrofit - Fans	1		
g.2 (29)	VFD Retrofit - Pumps			1
g.3 (30)	VFD Retrofit - Motors (process)			1
g.4 (31)	OTHER_VFD		1	
h.1 (32)	Retrofit - Motors			1
h.2 (33)	Retrofit - Chillers			1
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			1
h.4 (35)	Retrofit - Boilers			1
h.5 (36)	Retrofit - Packaged Gas fired heating			1
h.6 (37)	Retrofit - Heat Pumps			1
h.7 (38)	Retrofit - Equipment (custom)		1	
h.8 (39)	Retrofit - Pumping distribution method		1	

h.9 (40)	Retrofit - Energy/Heat Recovery			1
h.10 (41)	Retrofit - System (custom)		1	
h.11 (42)	Retrofit - Efficient Lighting			1
h.12 (43)	Retrofit - Building Envelope			1
h.13 (44)	Retrofit - Alternative Energy			1
h.14 (45)	OTHER_Retrofit		1	
i.1 (46)	Differed Maintenance from Recommended/Standard		1	
i.2 (47)	Impurity/Contamination		1	
i.3 ( )	Leaky/Stuck Damper		1	
i.4 ( )	Leaky/Stuck Valve		1	
i.5 (48)	OTHER_Maintenance		1	
j.1 (49)	OTHER		1	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**	
		• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**	
		• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**	
		• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**	
		• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**	
		• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**	
		• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**	
		• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**	
		• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**	
		• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**	
		• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**	
		• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**	
		• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**	
		• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**	
		• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**	
		• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**	
		• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**	
		• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**	
		• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**	
		• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**	
		• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**	
		• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**	
		• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: Main Campus

FWB Number:	16301	Eco Number:	1
Site:	Ridgewater CC Hutchinson	Date/Time Created:	5/31/2012

Investigation Finding:	AHU and RTU Operation Schedules Need Optimization	Date Identified:	10/1/2011
Description of Finding:	AHU and RTU operation schedules are excessive. Energy is wasted when outside air dampers open and fans operate during unoccupied hours		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Controls contractor	Benefits:	Optimizing outside air damper operation reduces energy used to treat excess outside air. Adjusting the supply and return air fan operations to the current building schedule reduces excessive run times and electrical energy use. It also increased the fan life.
Baseline Documentation Method:	Trending of outside air damper position, supply and return air fan operation, return air, make-up air, zone temperatures and discharge air temperatures in AHUs and RTUs were documented through the Building Automation System. The trended data for damper opening, supply and return air fan operation showed that outside air dampers opened and fans operated excessively during unoccupied hours.		
Measure:	Air Handling Units (AHU) and Rooftop Units (RTU) operating schedules shall be tailored to the current schedule of the spaces each unit serves.		
Recommendation for Implementation:	The building automation controls should be modified so that outside air dampers in AHUs and RTUs close when the building closes to the public at night and open two hours prior to the public opening in the morning. The outside air dampers should remain closed while the unit operates to maintain unoccupied temperature setpoints. The building automation controls should also be modified so that the supply and return air fan schedules for AHUs and RTUs correspond to their zone public occupancy schedule. When the unit's zone setpoint is met, supply and return air fans should turn off when the building closes to the public at night and remain off until two hours prior to the public opening in the morning. The fans should run during unoccupied hours only if their unit zone temperature setpoints are not met or during the two hour warm-up prior to public hours. The existing and proposed AHU and RTU operation schedules are summarized in the attached spreadsheet titled, "Revised AHU and RTU Schedules.xlsx".		
Evidence of Implementation Method:	The Building Automation System will collect trend data in 15 minute increments for the following points in all AHUs and RTUs: OA damper %, SF status, RF status, SF VFD %, RF VFD %, Discharge Air Temperature, Return Air Temperature, Mixed Air Temperature, and Outside Air Temperature. The trending should verify that the outside air damper closes and unit supply and return air fans turn off when the building closes to the public at night. The trending should verify that the dampers remain closed until two hours prior to unit's scheduled building opening hours. The trending should also verify that the supply and return air fans only operate during unoccupied times when the unit zone temperature setpoints are not met.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	38,239 $2,818	Annual Natural Gas Savings (therms): Estimated Annual Natural Gas Savings ($):	105 $89
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$2,250 $432 $2,682		

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$2,907 0.92 0.92 33	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	76.9%	Percent of Implementation Costs:	35.5%

Findings Details

Building: Main Campus

FWB Number:	16301	Eco Number:	2
Site:	Ridgewater CC Hutchinson	Date/Time Created:	5/31/2012

Investigation Finding:	Economizing Operations	Date Identified:	10/1/2011
Description of Finding:	Trend data for AHU 1, 3, 5, 6, 7, and 8 show that the economizer high limits not maximized. This setpoint is significantly lower than the typical optimum setpoint for Minnesota of 71°F. In addition, the outside air temperature sensor is out of calibration by -10F, causing the AHUs to economize at higher temperatures than ideal.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Economizer Operation - Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)		

Implementer:	Controls contractor or staff	Benefits:	Uses 'free cooling' when appropriate outside air properties exist instead of energy intensive mechanical cooling.
Baseline Documentation Method:	This finding was determined by looking at data from the BAS. The DAT, cooling valve, heating valve, damper, OAT, RAT, and MAT were used to help find the issue with the AHUs and RTUs		
Measure:	Change upper limit for economizing to 71F		
Recommendation for Implementation:	On AHU-1, 3, 5, 6, 7, and 8 reset the upper limit for economizing to 71F. Replace the outside air temperature sensor.		
Evidence of Implementation Method:	Trends will be gathered on the MAT, MAT Setpoint, SF status or VFD speed, RAT, DAT, OA Damper, RAT and OAT for 15 minute intervals when the OAT is between 55F and 76F to show the new economizer setpoints are working correctly. These trends will be gathered for a two week period to show it is working effectively.		

Annual Electric Savings (kWh):	1,756	Contractor Cost ($):	$750
Estimated Annual kWh Savings ($):	$129	PBEEEP Provider Cost for Implementation Assistance ($):	$432
		Total Estimated Implementation Cost ($):	$1,182

Estimated Annual Total Savings ($):	$129	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	9.13	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	9.13	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.4%	Percent of Implementation Costs:	15.7%

Findings Details

Building: Main Campus

FWB Number:	16301	Eco Number:	3
Site:	Ridgewater CC Hutchinson	Date/Time Created:	5/31/2012

Investigation Finding:	Over Ventilation.	Date Identified:	10/1/2011
Description of Finding:	RTU-1, 1A, 2, 2A, 3, 4, 5, 5A, 6, 8, 10, 11, and AHU-2 are over ventilating when Unit is not in economizer mode. When Units are not in economizing mode the units OA dampers should return to MINOASP. This is causing the units to heat/cool more air then needed.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Over-Ventilation - Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.		

Implementer:	Controls contractor	Benefits:	Save energy by not heating/cooling unneeded air
Baseline Documentation Method:	This finding was determined by looking at data from the BAS. The DAT, cooling valve, heating valve, damper, OAT, RAT, and MAT were used to help find the issue with the AHUs and RTUs		
Measure:	Set unit OA damper to return to MINOASP when units are not economizing, add economizer lockout of 71F		
Recommendation for Implementation:	When RTU-1, 1A, 2, 2A, 3, 4, 5, 5A, 6, 8, 10, 11, and AHU-2 are not economizing, schedule OA damper to return to MINOASP. Check to ensure OA dampers open fully when commanded wide open and close fully when commanded closed. Implement an economizer lockout of 71F so that the OA dampers return to MINOASP for all RTUs if not already in place.		
Evidence of Implementation Method:	Trends will be gathered on the MAT, MAT Setpoint, SF VFD, RAT, DAT, OA Damper and OAT for 15 minute intervals when the OAT is between 30F and 95 F to show the new economizer setpoints are working correctly. These trends will be gathered for a two week period in summer and winter to show it is working effectively.		

Annual Electric Savings (kWh): Estimated Annual kWh Savings ($):	5,031 $371	Annual Natural Gas Savings (therms): Estimated Annual Natural Gas Savings ($):	438 $372
Contractor Cost ($): PBEEEP Provider Cost for Implementation Assistance ($): Total Estimated Implementation Cost ($):	$3,250 $432 $3,682		

Estimated Annual Total Savings ($): Initial Simple Payback (years): Simple Payback w/ Utility Co-Funding (years): GHG Avoided in U.S. Tons (C02e):	$743 4.96 4.96 7	Utility Co-Funding for kWh ($): Utility Co-Funding for kW ($): Utility Co-Funding for therms ($): Utility Co-Funding - Estimated Total ($):	$0 $0 $0 $0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	19.7%	Percent of Implementation Costs:	48.8%

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

16301 - Ridgewater Hutchinson Main Campus

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	AHU & RTU schedules	AHU & RTUs		AHU and RTU schedules are excessive.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	SEE A1.1			
	a.3 (3)	Lighting is on more hours than necessary.	None		Investigation looked for, but did not find this issue.	Lighting followed building occupancy schedule.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	None		Investigation looked for, but did not find this issue.	No other Equipment scheduling/Enabling were found.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	AHUs	Main campus		Economizer setpoints are not maximized.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.	RTUs	Main campus		all RTU units over ventilate over 71F and some over ventilate under 40F.
	b.3 (7)	OTHER_Economizer/OA Loads	None		Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive	None		Investigation looked for, but did not find this issue.	No simultaneous heating & cooling was detected.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	None		Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	None		Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls	None			
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.	None		Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	None		Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	None		Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently	None		Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	None		Investigation looked for, but did not find this issue.	When zone temperture is met, VAV operate minimum setpionts
	d.6 (17)	Other_Controls (Setpoint Changes)	None			No other control issues found
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal	None		Investigation looked for, but did not find this issue.	Looking at trending data and plotting HWS VS OAT No issues were found with HW Reset.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal	None		Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal	None		Investigation looked for, but did not find this issue.	Looking at trending data and plotting DAT VS OAT No issues were found with SA Reset.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal				
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal	None		Not cost-effective to investigate	
	e.6 (22)	Other_Controls (Reset Schedules)	None			
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	None		Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled	None		Investigation looked for, but did not find this issue.	Did not notice any pump throttling
	f.3 (25)	Over-Pumping	None		Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.	None		Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction	None		Investigation looked for, but did not find this issue.	
	g.1 (28)	VFD Retrofit - Fans	AHU-2, 4-8; RTU-6,7, 8 &11			AHU-2, AHUs 4-8 and RTU-6,7, 8 &11 do not have VFD control.

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Rev. 2.0 (12/16/2010)

16301 - Ridgewater Hutchinson Main Campus

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	**g.2 (29)**	VFD Retrofit - Pumps	None		Not cost-effective to investigate	large pumps already hav vfds
	g.3 (30)	VFD Retrofit - Motors (process)	None			No Processes
	g.4 (31)	OTHER_VFD	None		Investigation looked for, but did not find this issue.	No issuesd found
h. Retrofits:	**h.1 (32)**	Retrofit - Motors	None		Not cost-effective to investigate	Payback would not be less than 15 years.
	h.2 (33)	Retrofit - Chillers	None		Not cost-effective to investigate	Payback would not be less than 15 years.
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	None		Not cost-effective to investigate	Payback would not be less than 15 years.
	h.4 (35)	Retrofit - Boilers	Hybrid HW boiler.		Not cost-effective to investigate	Owner has completed this type of project during the time of this study.
	h.5 (36)	Retrofit - Packaged Gas fired heating	Already gas fired.	Observation	Not Relevant	Gas is used throughout the facility
	h.6 (37)	Retrofit - Heat Pumps	None		Not cost-effective to investigate	Payback would not be less then 15 years
	h.7 (38)	Retrofit - Equipment (custom)	None		Investigation looked for, but did not find this issue.	No custom equipment
	h.8 (39)	Retrofit - Pumping distribution method	None		Investigation looked for, but did not find this issue.	Pumping distribution method is effective for building size and configuration.
	h.9 (40)	Retrofit - Energy/Heat Recovery	Some RTU/AHU's have Energy Recovery		Not cost-effective to investigate	Payback would not be less than 15 years
	h.10 (41)	Retrofit - System (custom)	None		Investigation looked for, but did not find this issue.	No custom equipment.
	h.11 (42)	Retrofit - Efficient Lighting	None		Not Relevant	Building was recently upgraded to more efficient lamps 10 years ago.
	h.12 (43)	Retrofit - Building Envelope	Not in Scope		Not Relevant	Was not in scope of services.
	h.13 (44)	Retrofit - Alternative Energy	Not in Scope		Not Relevant	Was not in scope of services.
	h.14 (45)	OTHER_Retrofit	None		Investigation looked for, but did not find this issue.	None without looking into large capital projects.
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard	None found.		Investigation looked for, but did not find this issue.	No problems found.
	i.2 (47)	Impurity/Contamination	None.		Investigation looked for, but did not find this issue.	None found.
	i.3 ( )	Leaky/Stuck Damper	None		Investigation looked for, but did not find this issue.	No problems found.
	i.4 ( )	Leaky/Stuck Valve	None		Investigation looked for, but did not find this issue.	None found.
	i.5 (48)	OTHER_Maintenance	None		Investigation looked for, but did not find this issue.	No comment
j. OTHER	**j.1 (49)**	OTHER	None		Investigation looked for, but did not find this issue.	No comment

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR RIDGEWATER COLLEGE HUTCHINSON

RIDGEWATER COLLEGE

creating opportunities. changing lives.

March 22, 2011

Campus Overview

Ridgewater College Hutchinson	
Location	2 Century Ave SE Hutchinson, MN 55350
Facility Manager	Kip Oveson
Number of Buildings	8
Interior Square Footage	195,906
PBEEEP Provider	Center for Energy and Environment (Neal Ray)
Date Visited	February 15, 2011
Annual Energy Cost (from B3)	$123,715 (February 2009 to February 2010)
Utility Company	Hutchinson Utilities Commission (Natural Gas and Electricity)
Site Energy Use Index (from B3)	83 kBtu/sq ft(2009)
Benchmark EUI (from B3)	129 kBtu/sq ft

Ridgewater College Hutchinson campus consist of three different building groups, the main campus which consists of the following buildings on the building list; Main, Maintenance Shop, Mezzanine, South Shop, Media Resource/Library, Northeast Wing. A pole shed which is right next to the main campus is classified as the NDT Metal Shelter. The East Campus is a different site in Hutchinson and is its own separate building with separate meters and a separate control system. The control system consists of thermostats on the wall the mechanical equipment is not on an automation system.

Building Name	State ID	Square Footage	Year Built
East Campus	E26271T0684	18,500	1984
Main	E26271T0172	80,000	1972
Maint Shop	E26271T0792	4,000	1990
Media Resource/Library	E26271T0801	45,316	2001
Mezzanine	E26271T0475	2,090	1975
NDT Metal Shelter (Not Investigated)	E26271T0578	12,000	1971
Northeast Wing	E26271T0375	19,000	1975
South Wing	E26271T0275	15,000	1975

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of Ridgewater College Hutchinson was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on February 15, 2011 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Ridgewater College Hutchinson is a 195,906 square foot (sqft) complex located in Hutchinson, MN. The buildings primarily consist of classroom space, laboratory, library, and administration space.

Recommendation for Investigation

An investigation of the energy usage and energy savings opportunities of Ridgewater College Hutchinson is recommended. The NDT Metal Shelter will not be part of this investigation.

There are many factors that are part of the decision to recommend an energy investigation of a building; at Ridgewater College Hutchinson some of the characteristics that were taken into account during the building selection process include:

- Potential energy savings opportunities observed during screening phase
- Moderate square footage
- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation

Building Overview Section

Mechanical Equipment

There are a total of seven boilers which were installed two years ago that supply hot water for heating to all mechanical equipment in the main campus. There are two separate hot water loops associated with boilers. One is hot water directly from the boilers and is used primarily for the VAV reheats. This loop contains three hot water pumps all of which have VFDs. The other loop runs through a water to water heat exchanger which transfers energy from the hot water from the boilers to a glycol hot water loop which serves the heating coils in the AHUs. This loop consists of two hot water pumps which also contain VFDs.

There is an air cooled chiller which produces chilled water for eight AHUs located at the main campus. The chiller has a primary chilled water pump and secondary chilled water pump. The secondary chilled water pump utilizes a VFD.

The main complex contains eight AHUs and eighteen RTUs. All the RTUs utilize DX cooling. Thirteen of the roof top units and three of the AHUs contain VAV boxes; the campus contains a total of 122 VAV boxes with reheat coils. The science RTU contains an energy recovery wheel due to the large amount of exhaust air from the space.

The East Campus contains three RTUs which are gas fired and contain DX cooling. They serve multiple spaces and are controlled by single thermostat located in one of the spaces the unit serves.

The NDT Metal Shelter does not contain mechanical equipment within the building and is used primarily as storage. This building will not be included in the investigation.

The following table lists the key mechanical equipment at the facility.

Mechanical Equipment Summary Table	
Quantity	**Equipment Description**
8	Air Handling Units
21	Roof Top Units (18 RTUs on main campus, 3 RTUs on East campus)
7	Hot Water Boilers
1	Chiller
9	Pumps (Chilled water and Hot water)
1	Water to water HX
1	Fan coil units
9	Powered Roof Ventilator
4	Fume Hoods
122	Variable air volume boxes
2315	Points On the Automation System
670	Minimum Points To Be Trended
15	Data Loggers Required (3 fan status and 12 temperature)

Controls and Trending
The main campus building runs on a Schneider Electric-IA automation system. The system is capable of trending and archiving trend information. A log in to Workplace Pro would be required by a provider to further set up trends. This log in can be granted by working with Ridgewater Staff and the control contractor for the site, there is no additional cost to the provider to gain this log in. Currently all major mechanical equipment located within the main campus structure is automated. The system has approximately 200 points being trended right now.

The RTUs at the East Campus are controlled by thermostats mounted on the wall, there is currently no automation for this complex and data logging would be required for trending at this complex.

Lighting

Indoor lighting- Interior lighting consists of T8 32 watts lamps. There are few areas which still have T12 lights, but these areas rarely have the lights on and the savings associated from replacing them would not be significant. Most of the lights are controlled by light switches.

Energy Use Index B3 Benchmark
The site Energy Use Index (EUI) for the building is 83 kBtu/sqft, which is 35% lower than the B3 Benchmark of 129 kBtu/sqft. The site EUIs for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks on average. This shows Ridgewater College Hutchinson is performing better than the average state building.

Metering
The complex contains two electrical meters for the main campus, one which feeds all the main buildings and another electrical meter for the Maintenance Shop. The east campus contains one electrical meter. There are two different gas meters, one for the main campus and one meter for the East Campus.

Documentation
The building had building plans for all projects which were performed on it including the original as built plans. All equipment information was easy to locate and readily available. Control sequences and test and balance reports do exist and can be located in file cabinets.

Additional Information form Occupants Interviews and Observations
The following information **has not been verified** and was obtained through occupant interviews and/or general observations by the PBEEEP Screening team. This information is provided for reference only:
- 3 RTUs had their supply fans running at 100% and could not meet duct static
- 2 RTUs had supply fan speeds below 25%
- 3 HWPs were running at 100%
- Hot Water reset could be optimized in the boilers
- Airflow sensors may need to be calibrated
- 3 RTUs have a point for Room CO2 setpoint, but not point for Room C02
- The 3 RTUs at the East Campus are not on the automation system and are controlled by thermostats on the wall.

Building Summary Table

The following tables are based on information gathered from interviews with facility staff, a building walk-through, automation system screen-captures, and equipment documentation. The purpose of the tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge.

Ridgewater College Hutchinson					
Area (sqft)	177,406	Year Built	1971-2001	EUI/Benchmark	83/135
HVAC Equipment					

Air Handlers (8 Total)

Description	Type	Size	Notes
AHU 1	Variable volume with VFD on SF and RF	3,400 CFM 5 HP SF 1.5 HP RF	5 VAVs associated with unit
AHU 2	Variable volume with VFD on SF	8,000 CFM 10 HP SF	
AHU 3	Variable volume with VFD on SF and RF	9,000 CFM 10 HP SF 5 HP RF	21 VAVs associated with unit
AHU 4	Variable volume with VFD on SF	5,800 CFM 7.5 HP SF	
AHU-5	Variable volume with VFD on SF	3,600 CFM 5 HP SF	
AHU-6	Variable volume with VFD on SF	3,600 CFM 5 HP SF	
AHU-7	Variable volume with VFD on SF and RF	3,330 CFM 5 HP SF 1.5 HP RF	11 VAVs associated with unit
AHU-8	Variable volume with VFD on SF	4,200 CFM 7.5 HP SF	

HVAC Equipment Cont'd

Roof Top Units (18 Total)

Description	Type	Size	Notes
RTU-1	Variable volume with VFD on SF and RF	3,800 CFM 5 HP SF; 3 HP RF	5 VAV associated with unit
RTU-2	Variable volume with VFD on SF and RF	2,600 CFM 5 HP SF; 3 HP RF	4 VAV associated with unit
RTU-3	Variable volume with VFD on SF and RF	5,200 CFM 5 HP SF; 3 HP RF	5 VAV associated with unit
RTU-4	Variable volume with VFD on SF and RF	8,800 CFM 7.5 HP SF; 5 HP RF	7 VAV associated with unit
RTU-5	Variable volume with VFD on SF and RF	5,150 CFM 5 HP SF; 3 HP RF	8 VAV associated with unit
RTU-6	Constant Volume SF and RF	7,200 CFM 5 HP SF; 3 HP RF	
RTU-7	Constant Volume SF and RF	6,200 CFM 5 HP SF; 3 HP RF	
RTU-8	Constant Volume SF and RF	6,000 CFM 5 HP SF; 3 HP RF	
RTU-9	Variable volume with VFD on SF and RF	4,500 CFM 5 HP SF; 3 HP RF	7 VAV associated with unit
RTU-10	Variable volume with VFD on SF and RF	4,650 CFM 5 HP SF; 3 HP RF	8 VAV associated with unit
RTU-11	Variable volume with VFD on SF and RF	5,750 CFM 5 HP SF; 3 HP RF	8 VAV associated with unit
RTU-12	Constant Volume SF and RF	4,200 CFM 5 HP SF; 3 HP RF	
RTU-1A	Variable volume with VFD on SF and RF	3,750 CFM 5 HP SF; 3 HP RF	5 VAV associated with unit
RTU-2A	Variable volume with VFD on SF and RF	3,850 CFM 5 HP SF; 3 HP RF	5 VAV associated with unit
RTU-3A	Variable volume with VFD on SF and RF	4,050 CFM 5 HP SF; 3 HP RF	6 VAV associated with unit
RTU-5A	Variable volume with VFD on SF and RF	6,850 CFM 5 HP SF; 3 HP RF	9 VAV associated with unit
RTU-6A	Variable volume with VFD on SF and RF	4,800 CFM 5 HP SF; 2 HP RF	8 VAV associated with unit
RTU-1 Science Labs	Heat recovery with VFD on SF and RF	7,500 CFM 10 HP SF; 7.5 HP RF	Contains a condensing unit for cooling rated at 20 tons.
RTU-1	Constant Volume	6,645 CFM	Serves the East Campus, not on the automation system.
RTU-2	Constant Volume	6,720 CFM	Serves the East Campus, not on the automation system.
RTU-3	Constant Volume	14,000 CFM	Serves the East Campus, not on the automation system.

HVAC Equipment Cont'd

Hot Water System

Description	**Type**	**Size**	**Notes**
Boiler-1 Boiler-2 Boiler-3 Boiler-4 Boiler-5 Boiler-6 Boiler-7	Hot water boilers	260 kBtu/hr	All boilers are new and installed in 2007
HX-1	Water to glycol HX	3,503 kBtu/hr	Associated with hot water serving AHUs
HWP-1 through HWP-3	Variable volume	5 HP 190 gpm	Supplies HW to VAV boxes
GP-1 and GP-2	Variable volume	5 HP 208 gpm	Glycol system which supplies water to AHUs
Other GP-1 and GP-2	Constant volume	1/3 HP 10 gpm	Used for underfloor heating system

Chilled Water System

Description	**Type**	**Size**	**Notes**
Chiller-1	Air cooled	140 tons	
Primary Pump-1	Constant volume	3 HP 257 gpm	
Secondary Pump-2	Constant volume	7.5 HP 257 gpm	

HVAC Equipment Cont'd

Fan Coil Units (1 Total)

Description	Type	Size	Notes
FC-1	AC Unit	840 CFM 1/6 HP SF	

Powered Roof Ventilator (9 Total)

Description	Type	Size	Notes
PRV-1 through PRV-9		175 to 550 CFM	

Chemistry fume Hoods (4 Total)

Description	Type	Size	Notes
FHV-1 through FHV-4	Fume Hood	750 CFM each	Associated with exhaust for RTU-1 Science Labs

Booster Coils (7 Total)

Description	Type	Size	Notes
BC-1 through BC-7	Reheat Coils	Rated for between 155 to 2,150 CFM	Associated with exhaust for RTU-1 Science Labs

VAV boxes (122 Total)

Description	Type	Size	Notes
122 VAV boxes	Reheats	150 to 940 CFM	VAV boxes are associated with 13 RTUs and 3 AHUs

Points on BAS

Air Handlers

Description	Points
AHU-1 AHU-3 AHU-7	OA damper %, Mixed air damper %, MAT, Face/Bypass damper %, Cooling valve %, Heating valve %, SF command, SF VFD %, Duct static pressure, DAT, Dehumidify command, RAT, RARH, RF VFD, Building pressure, Relief damper %, Night setup setpoint, Outside air min setpoint, Nigh setback setpoint, cooling enable setpoint, Heating enable setpoint, Discharge air setpoint, Morning warmup setpoint, Mixed air setpoint, BLDG pressure setpoint, Economizer setpoint, Duct static pressure setpoint
AHU-2 AHU-5 AHU-6 AHU-8	OA damper %, Mixed air damper %, MAT, Cooling valve %, Heating valve %, SF command, DAT, Dehumidify command, Room temperature, Space pressure, RAT, RARH, Relief damper %, Radiation valve %, Night setup setpoint, Outside air min setpoint, Nigh setback setpoint, Cooling enable setpoint, Heating enable setpoint, Radiation setpoint, Discharge air setpoint, Morning warmup setpoint, Mixed air setpoint, BLDG pressure setpoint, Economizer setpoint
AHU-4	OA damper %, Mixed air damper %, MAT, Cooling valve %, Heating valve %, SF command, DAT, Dehumidify command, Room temperature, Space pressure, RAT, RARH, Relief damper %, Radiation valve %, Night setup setpoint, Outside air min setpoint, Nigh setback setpoint, Cooling enable setpoint, Heating enable setpoint, Radiation setpoint, Discharge air setpoint, Morning warmup setpoint, Mixed air setpoint, BLDG pressure setpoint, Economizer setpoint, Humidity setpoint

Cold Water System

Description	Points
Chiller	Chiller command, Primary CHWST, Primary CHWRT, Differential pressure 1, Differential pressure 2, Differential pressure 3, OAT, OARH, Pump 2 speed %, Chiller enable setpoint, Cold water DP setpoint, Cold water supply setpoint

Hot Water System

Description	Points
System	OAT, OARH, Pump 1 command, Pump 1 VFD %, Pump 2 command, Pump 2 VFD %, Pump 3 command, Pump 3 VFD %, Glycol pump 1 command, Glycol pump 2 command, Bypass valve %, HWST to VAVs, HWRT from VAVs, HWST to AHUs, HWRT to AHUs, VAV hot water differential pressure, Glycol loop enable setpoint, glycol differential pressure setpoint, Glycol supple setpoint, VAV reheat enable setpoint

VAV boxes

Description	Points
VAV-1 through VAV-122	Supply air from AHU:, Damper %, Reheat valve %, VAV box DAT, Box flow, Box flow setpoint, Max flow, Min flow, Reheat flow, Room temperature, Active setpoint, Room setpoint, Unoccupied setpoint

Chemistry Lab Hoods

Description	Points
Lab Hoods	Hood alarm, Sash Position, Hood CFM

Points on BAS Cont'd

Roof Top Units

Description	**Points**
RTU-1 RTU-2 RTU-3 RTU-4 RTU-9 RTU-2A	OA damper %, Mixed air damper %, MAT, SF command, SF VFD %, Heating valve %, DX stage 1, DX stage 2, Duct static pressure, DAT, Supply air CFM, RAT, RARH, RA duct static pressure, RF VFD, Exhaust duct static, Relief damper %, Supply air setpoint, Duct static pressure setpoint, Return fan tracking, Mixed air setpoint, Min outside air setpoint, Warm-up setpoint, Cooling enable setpoint, Heating enable setpoint, Night setback, Night setup, Dehumidification mode, Dehumidification mode setpoint
RTU-5 RTU-10 RTU-11 RTU-1A RTU-3A RTU-5A RTU-6A	OA damper %, Mixed air damper %, MAT, SF command, SF VFD %, Heating valve %, DX stage 1, DX stage 2, Duct static pressure, DAT, Supply air CFM, RAT, RARH, RF VFD, Relief damper %, Supply air setpoint, Duct static pressure setpoint, Return fan tracking, Mixed air setpoint, Min outside air setpoint, Warm-up setpoint, Cooling enable setpoint, Heating enable setpoint, Night setback, Night setup, Dehumidification mode, Dehumidification mode setpoint
RTU-6	OA damper %, Mixed air damper %, MAT, SF command, Heating valve %, DX stage 1, DX stage 2, DX stage 3, DX stage 4, DAT, Supply air CFM, Room temperature, Room OC2, RAT, RARH, Relief damper %, Supply air setpoint, Room CO2 setpoint, Mixed air setpoint, Min outside air setpoint, Warm-up setpoint, Cooling enable setpoint, Heating enable setpoint, Night setback, Night setup
RTU-7 RTU-12	OA damper %, Mixed air damper %, MAT, SF command, Heating valve %, DX stage 1, DX stage 2, DX stage 3, DX stage 4, DAT, Supply air CFM, Room temperature, RAT, RARH, Relief damper %, Supply air setpoint, Room CO2 setpoint, Mixed air setpoint, Min outside air setpoint, Warm-up setpoint, Cooling enable setpoint, Heating enable setpoint, Night setback, Night setup
RTU-8	OA damper %, Mixed air damper %, MAT, SF command, Heating valve %, DX stage 1, DX stage 2, DX stage 3, DX stage 4, DAT, Supply air CFM, Room temperature, RAT, RARH, Relief damper %, Supply air setpoint, Mixed air setpoint, Min outside air setpoint, Warm-up setpoint, Cooling enable setpoint, Heating enable setpoint, Night setback, Night setup
RTU-1 Science Labs	OA damper %, SF command, SF VFD %, Heat valve %, DX stage 1, DX stage 2, DAT, Duct static pressure, RARH, RA duct static pressure, RF VFD %, Heat wheel status, Relief damper %, Supply air setpoint, Duct static setpoint, Return fan duct static setpoint, Htg/Clg switch over setpoint, Night setback

Building Floor Plans

PBEEEP State Government

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HUH	Horizontal Unit Heater
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CUH	Cabinet Unit Heater	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	PTAC	Packaged Terminal Air Conditioner
DSP	Duct Static Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FPVAV	Fan Powered VAV	UH	Unit Heater
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes
HP	Horsepower	VUH	Vertical Unit Heater

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH